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Collaboration trend in Indian Business-Management research: A bibliometric perspective

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Introduction

Collaboration is a significant factor in scholarly productivity. It is a process in which knowledge and innovation flow among scientists, and individual scientists thus acquire access to new ‘‘capital’’ directly through collaboration between individuals and indirectly through the collaborators of their collaborators (Yin et al. 2006). Katz and Marin (1997) define research collaboration as ‘the working together of researchers to achieve the common goal of producing new scientific knowledge’. Research collaboration is a key mechanism that links distributed knowledge and competencies into novel ideas and research avenues (Heinze and Kuhlmann 2008). In other words, research collaboration connects different sets of talents to produce a research output. Bordon & Gomez (2000) indicates that one among the various reasons for the growth in collaboration is the increasing specialization within disciplines, such that multiple partners are often needed to tackle complex research problems. Another is economics, given the need to amortize expensive laboratory equipment, computers, data, and other resources across multiple researchers and projects. Yet another is sources of funding that encourage larger projects (Bordons & Gomez, 2000). There is ample evidence that collaboration is a key factor influencing research productivity, and academics that prefer independent or collaborative work tend to show differences in productivity as measured by research publication (Katz & Martin, 1997). But the productivity counts may vary based on the method of allocating authorship (one credit for each publication vs. partial credit based on number of authors, etc.).Tibor Braun et al.(2001) has studied on the relation between the productivity and co-operativity (collaboration) of authors in neuroscience journals and found that there is a peak of productivity around the co-operativity value of 4-5 (papers with 5-6 authors). Persson et.al (2004) points that if productivity (papers per author) is growing faster than the number of publications then an intensifying scientific collaboration and an increasing density of co-publication networks is the only possible explanation.

Collaboration in Business Management

Collaboration is also to a large extent dependent on the characteristics of the research field. Frame and Carpenter (1979) state that the fact that most disciplines differ in their epistemological and methodological characteristics makes research collaboration a complex matter. The nature of the discipline can restrain as well as encourage the degree of collaboration. There are large differences across various academic disciplines with respect to the extent of co-authorship in scholarly publishing. According to (Bordons & Gomez, 2000;

Meadows, 1998 number of publications vary by discipline, so do collaborations and coauthorships. Solo research is the norm in some disciplines, particularly in the humanities, social sciences, and business (soft disciplines). Joint authorship is closely connected to teamwork in research, which is much less common in soft sciences compared to hard disciplines such as natural sciences, engineering, and medical science. (Kyvik, 2003). Collaboration is a form of boundary crossing between disciplines (Pierce, 1999; Qin, Lancaster, & Allen, 1997). As business management is of cross disciplinary in nature which engulfs both social science and technology as it bears significant collaboration between researchers of both social science and technological subjects and can be considered as a bridge connecting the two fields. With the growth of multidiscipline/cross-discipline collaboration, team members engage in more diverse types of academic interaction, conflict resolution, and accountability.

Facets and structure of scientific collaboration

Scientific collaboration is a complex social phenomenon in research that has been systematically studied since the 1960s.). Bibliometric methods offer a convenient and non-reactive tool for studying collaboration in research by co-authorship statistics. Bibliometric studies of collaboration generally assesses the scientific cooperation between scholars usually as evidenced by number of co-authors(individual), between institutes(institutional) and between countries(international) of collaborating institutes. According to Persson et.al.(2004) Scientific collaboration as measured by means of co-authorship patterns has considerably increased during the last decades and studied at all levels of aggregation.Many of the researchers have studied the collaboration at different levels such as macro level Glanzel(2001, meso level) Gomez(1995) and micro level (Ding, 1999); Glanzel, 2002). *Kretschmer* (1997) has analysed aspects of social stratification in scientific collaboration at the micro (individual) level and finds that extramural collaboration is characterised by similarity of the social status whereas intramural collaboration shows significant differences of the social status of the co-authors. Co-operation between different sectors such as university(academic), industry and government(non-academic) is studied as a sectoral collaboration. Institutional collaboration is shaped by institutional sectors (scientific co-operation between universities and between firms, respectively) and this collaboration across sectors is characterized by regional or national peculiarities.

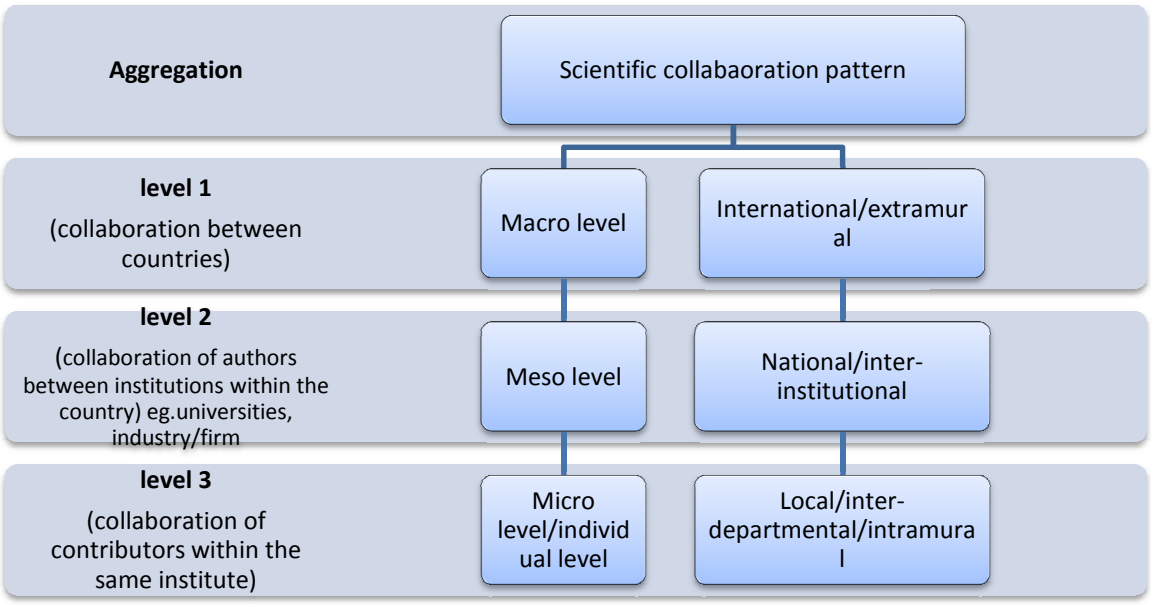

Figure 1 Levels of scientific collaboration.

Previous studies

Studies of collaboration often are a form of evaluative analysis, it can be used to assess the level of partnerships between countries and between institutes. Several investigators have conducted bibliometric studies of nature and pattern of research collaboration in different disciplines. **Arunachalam and Doss (2000)** studied on the international collaboration in science in Asia through co-authorship analysis and finds that there is constant growth in international collaboration. **Garg and Padhi (2001)** has studied analysis on collaboration pattern in Laser science and technology India at different aggregations as local (inter-departmental), domestic (inter-institutional) and international collaboration. **Sevukan (2007)** has done similar analysis on the collaboration of faculties of plant sciences in central universities in International level, national level and local level and found that the faculties of the four central universities collaborate at international level and the national& local level collaboration is also fairly good due to the reduction of geographical barrier by recent advances in technology and ICT. **Kumar and Jan (2012)** in their study examined research collaboration trends in Malaysia using bibliometrics and network analysis within the field of BM in Malaysia at the individual, institutional, and international levels and found that Malaysian institutions have collaborated more intra-institutionally or with their foreign partner institutions than with other institutions within the country. Internationally co-authored papers were cited three times more than locally co-authored papers. Further, the study of business management discipline in Indian context was done by **Kumar and Dora(2012)** to identify the trends of researchers from IIM-A (Indian institute of Management, Ahmedabad)

for the period 1999 to 2010 and the results shows that the single authored papers have reduced over a period of time and the collaboration with authors from abroad(international collaboration was highest in 2003 and 2006 and afterwards shows a decline. The present study projects to measure the nature and pattern of collaboration in Business Management research in India considering the whole country's output, not limiting to a particular institute, with special focus given to international level collaborations.

Bibliometric indicators for measuring the extent of scientific collaboration

Scientific collaboration has become one of the favourite topics in bibliometric research. Bibliometrics offers a powerful set of methods and measures for studying the structure and process of scholarly communication. Some important bibliometric parameters and indices employed to analyze the data are defined below.

a. Collaborative index

Collaborative index (Lawani, 1980) is a mean number of authors per joint paper. For this analysis, we have omitted the single authored papers which is equal to one always. The mean number of authors per joint authored paper.

$$CI = (Total\ authors)/(Total\ joint\ author)$$

which is calculated using the formula,

$$CI = \frac{\sum_{j=1}^{A} j f_j}{N}$$

----------(1)

Where,

f_j is the number of *J* authored papers published in a discipline during a certain period of time

N is the total number of research papers published in a discipline during a certain period of time

b. **Degree of Collaboration**

To examine the extent of research collaboration of scientists of BM, Subramaniam's[3] formulas are adopted.

$$C = \frac{\mathrm{Nm}}{(\mathrm{N\,m} + \mathrm{N\,s})}$$

----------(2)

C= Degree of collaboration of scientists

N m = Number of multiple authored Papers

N s = Number of single authored papers

c. Collaborative Coefficient

Collaborative coefficient (CC), suggested by Ajiferuke(1988) and used by Karki and Garg(1997) has been used to measure the extent and strength of collaboration among the researchers in India in the BM discipline . It can be expressed mathematically as:

$$CC = 1 - \sum_{j=1}^{j=k} (1 - \mathrm{J})^{F_j/_N}$$

----------(3)

Where,

f_j is the number of *J* authored papers published in a discipline during a certain period of time *N* is the total number of research papers published in a discipline during a certain period of time and *k* is the greatest number of authors per paper in a discipline.

According to Ajiferuke, CC tends to zero as single authored papers dominate and to 1-1/j as j-authored papers dominate. This implies that higher the value of CC, higher the probability of multi or mega authored papers.

d Participative Index (PaI)

To evaluate the performance of research of an institution, an index called 'participative Index (PaI) (Gracia, et.al., 2005; Sevukan, 2007) has been calculated. *PaI* is the ratio of the number of papers in a country or institution and the total number of documents collected in this repertoire. This can be expressed as:

$$PaI = \frac{No.of\ papers\ generated\ in\ an\ institution}{Total\ number\ of\ documents\ collected\ in\ this\ repertoire} X\ 100$$

Methodology of the study

This study comprises articles retrieved from academic journal publications covered by EBSCO subject specific database–Business Source Premier(BSP) during the time span 1997-2012 which contain at least one Indian affiliation in the 'author address' field (AU). Affiliations of authors are coded at the time of paper publication. In order to interpret collaboration and co-publication appropriately different approaches and analyses are used at each level of aggregation. The full or integer counting scheme which assigns a co-publication

fully to each contributing unit is used for measuring the authorship since for the analysis of collaboration patterns as well as comparisons of relative publication activity requires full-address counts. The institutional affiliation entered in the original data from the bibliographic data sources is to serve as the basis for crediting publications to different institutions. For the purpose of studying institutional collaboration entries from different departments within an institution have been grouped under the name of parent institution to which they belong. International collaboration is assigned if there is atleast one foreign address in the affiliation of contributers. When the co-authors from a given country were more than one, collaboration between the countries was attributed only once. For instance, an article published in co-authorship by two institutions in India, one in France and two in the USA has been assigned as one article for India, one for France and one for the USA. On analysis of the downloaded bibliographic data using endnote programme and MS-Excel, it is observed that 17514 authors have contributed 7998 articles. For studying the aggregations of collaboration, only papers which are co-authored (5440) are considered. Further, to display the micro structure of collaboration pattern tools such as Bibexcel and GPS visualizer is used .The study also compiles the productive institutions in India which have contributed 15 or more research publications.

Objectives of the study

The present study is aimed to examine the influence of research collaboration on research Business management research productivity using co-authored papers. The following are the specific objectives of the study

1. To examine the quantum and growth of single and co-authored papers in the discipline
2. To measure the extent of scientific collaboration using bibliometric indices
3. To check whether the collaboration leads to an increase in the total productivity
4. To analyse the collaboration trends at different aggregations such local, national and international level.
5. To identify the collaborations between academics and non academics in the discipline.
6. To identify the geographical(country) preference of Indian authors in International collaboration
7. To rank prolific institutions contributing to BM research in India.

Analysis and discussion

The data sample comprises 7998 articles retrieved from the EBSCO- Business Source Premier database during the time span 1997-2012 containing at least one Indian affiliation. The summary of the descriptive statistics are given in table 1. A total of 17514 contributors in the dataset, of which 54.3 percent are co-authors. The mean author per paper is 2.24, where as the mean collaborator per paper is calculated as 1.24. In the data set , only 31.98 articles are single authored and rest 68.02% is written by two and more authors, which shows that that there is a clear trend towards collaboration.

Table 1

Descriptive statistics of co-publication behaviour of Indian business management researchers

Publication	Count	Percentage
Total publication	7998	100.00
Single author	2258	31.98
Co-authored	5440	68.02
Authors		
Total contributors	17514	100.00
No. of main authors	7998	45.67
No. of collaborating authors(co-authors)	9516	54.33
Mean author per paper	2.24	
Mean co-author per paper	1.77	
Authorship		
One author	2258	31.98
Two author	3066	38.33
Three author	1582	19.78
Four author	488	6.1
≥Five author	304	3.8
Collaboration level		
International	1652	20.66*
National	1938	24.23
Local	1850	23.13

* (Out of total publication)

Collaboration and productivity

The year wise distribution of co-authored publication reports a gradual increase from 0.44 percent in 1997 to 11.08 percent in 2012. The growth of co-authored publications during the

study period is calculated as 37.94 percent and single authored papers as 42.7 percent using the log- linear model. From Figure 1, it is apparent that the single authored publications also show a gradual increase during the period. Hence, it was checked if collaboration on papers led to an actual increase in the total number of papers (productivity) produced using the correlation statistics.The correlation analysis between the number co-authored publications and total productivity from 1997-2012 shows the high positive correlation with the correlation co-efficient(r) of 0.99 between the collaboration and productivity.

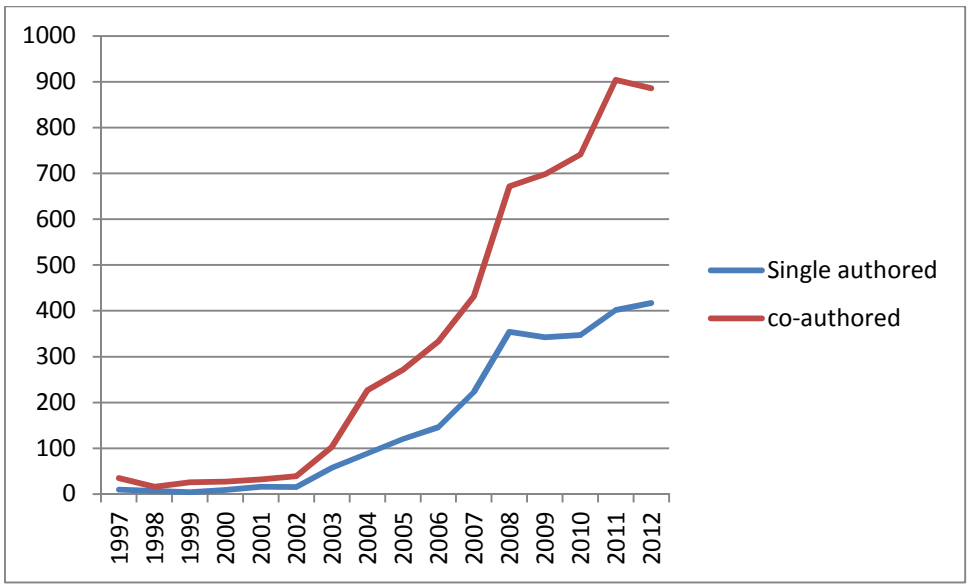

Figure 1 Single authored and co-authored papers

Authorship pattern in co-authored publications

Figure 2 reveals the authorship pattern of co-authored publications. Among the 5440 publications which are joint authored, the largest group of 38.33 percent of papers was contributed by 2 authors, followed by 19.78 per cent papers by 3 authors and 6.1 per cent of papers by 4 authors. Figure 2 presents the percentage share of author producing 1, 2 … papers a year. It also clearly reveals that as the number of authors collaborating increases the number of papers decreases. A significant portion of the papers, about 96 per cent, are covered by single author, two-author, and three-author and four-author partnerships.

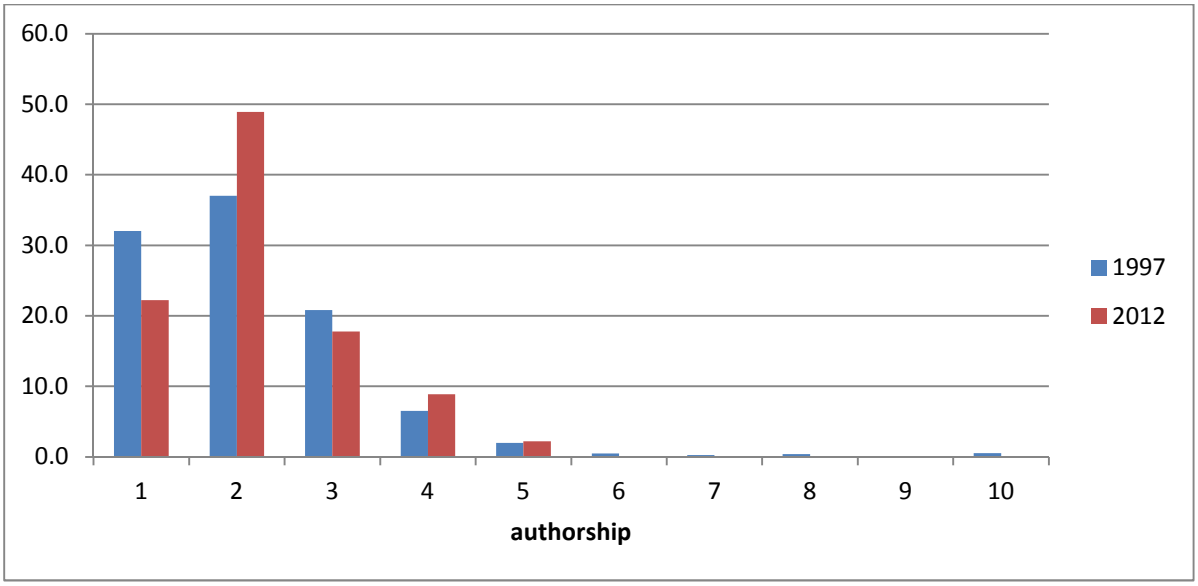

Figure 2 Authorship pattern in co-authored publications.

Collaboration indices

The strength and extent of collaboration in BM research are further analysed by the indices using the equations 1, 2 & 3 and presented in the table 2. The three indices shows highest value in 1998 and 1999.The degree of collaboration shows an decrease from 0.78 in 1997 to 0.68 in 2012. According to Ajiferuke collaboration co-efficient tends to zero as single authored papers dominate. This implies that higher the value of CC, higher the probability of multi or mega authored papers. In this study we found mean value of CC as 0.415 which is far from 0. Hence, in Business Management the number of multi or mega authored papers could be considerable. The analysis shows that all the three indices gradual decline during the period of study which indicates an overall decreasing trend of collaborative research in Business Management research in India.

Table 2

Year wise distribution of co-authorship patten and collaborative indices

Year	1	2	3	4	5	6	7	8	9	10 & above	Total authors	Total articles	CI	CC	DC
1997	10	22	8	4	1	0	0	0	0	0	99	45	2.2	0.45	0.78
1998	7	8	4	3	0	0	0	0	0	1	57	23	2.48	0.43	0.7
1999	4	18	5	2	0	1	0	0	0	0	69	30	2.3	0.49	0.87
2000	9	21	5	0	1	0	0	0	0	0	71	36	1.97	0.41	0.75
2001	16	18	7	5	0	0	1	0	0	1	113	48	2.29	0.4	0.67
2002	15	13	18	7	0	1	0	0	0		129	54	2.39	0.45	0.72

2003	57	56	30	10	2	3	1	0	0	1	348	160	2.15	0.38	0.64
2004	89	135	62	15	5	0	1	3	2	3	724	315	2.25	0.42	0.72
2005	120	140	88	24	8	6	1	1	2	1	880	391	2.24	0.42	0.69
2006	146	165	108	26	13	6	2	0	2	11	1203	479	2.39	0.42	0.66
2007	223	239	130	27	19	7	3	3	4	0	1417	655	2.16	0.39	0.66
2008	354	400	179	65	13	5	0	3	0	6	2144	1025	2.08	0.38	0.66
2009	342	404	196	68	8	8	3	3	0	8	2255	1040	2.14	0.39	0.67
2010	347	434	193	77	21	7	2	2	1	4	2335	1088	2.14	0.4	0.68
2011	402	511	278	70	21	8	9	4	1	2	2817	1306	2.16	0.41	0.69
2012	417	482	271	85	26	6	3	5	1	7	2853	1303	2.18	0.4	0.68
Total	2558	3066	1582	488	138	58	26	24	13	45	17514	7998	Mean		
%	31.98	38.33	19.78	6.1	1.73	0.73	0.33	0.3	0.16	0.56		100	2.2	0.415	0.702

(Columns in blue shows the maximum value)

Levels of collaboration

The data collected for the study is further analysed for looking at the collaboration level undertaken by BM researchers. The affiliation of co-authors was explored in three levels of collaboration as IL–International level (collaboration between Indian and foreign contributors). International collaboration is assigned to publications if there is atleast one address from country other than India in the address by-line) NL-National level (collaboration of authors between different institutions within India) and LL-local level (collaboration of contributors within the same institute or department). Table 3 shows that collaboration at national level comprises of 35.63 percent of the co-authored publications and was followed by collaboration at local level with 34 per cent of publications. The international level collaboration is reported by 30.37 percent of publications. It is interesting to note that although there has been a overall increase in international collaborative papers, the number of papers with international collaboration category have declined from 2008 onwards in relation to the national and local collaborated papers which indicates a decrease in the international collaboration trend of Indian researchers. But a subsequent increase of national level collaboration is also observed from 2008 onwards. The collaboration with authors from abroad was highest in 2000 to 2002, though the number of papers published during those years was relatively less. According to Luukkonen, Persson and Sivertsen (1992) countries with less developed scientific infrastructure tend to have higher rates of international collaboration as they have practically no other choice than to find collaborating partners from outside their borders. In India, percentage of international level collaboration decreases from 34.29 percent in 1997 to 28.33 percent in 2012. The proliferation of Business schools in the private sector in India, which have created ample collaboration opportunities

within the country at national and local level, could be one of the possible explanations that could justify the decrease in the international collaboration among the researchers with subsequent rise of national level collaboration.

Table 3

Year wise analysis of collaboration at different levels

Year	Publications						
	IL	%	NL	%	LL	%	Total
1997	12	34.29	10	28.57	13	37.14	35
1998	7	43.75	4	25.00	5	31.25	16
1999	9	34.62	5	19.23	12	46.15	26
2000	13	48.15	5	18.52	9	33.33	27
2001	17	53.13	7	21.88	8	25.00	32
2002	23	58.97	8	20.51	8	20.51	39
2003	50	48.54	30	29.13	23	22.33	103
2004	79	34.96	64	28.32	83	36.73	226
2005	87	32.10	91	33.58	93	34.32	271
2006	120	36.04	113	33.93	100	30.03	333
2007	158	36.57	132	30.56	142	32.87	432
2008	175	26.08	258	38.45	238	35.47	671
2009	204	29.23	247	35.39	247	35.39	698
2010	207	27.94	269	36.30	265	35.76	741
2011	240	26.55	351	38.83	313	34.62	904
2012	251	28.33	344	38.83	291	32.84	886
Total	1652 (30.37%)		1938 (35.63%)		1850 (34.00%)		5440 (100.00%)

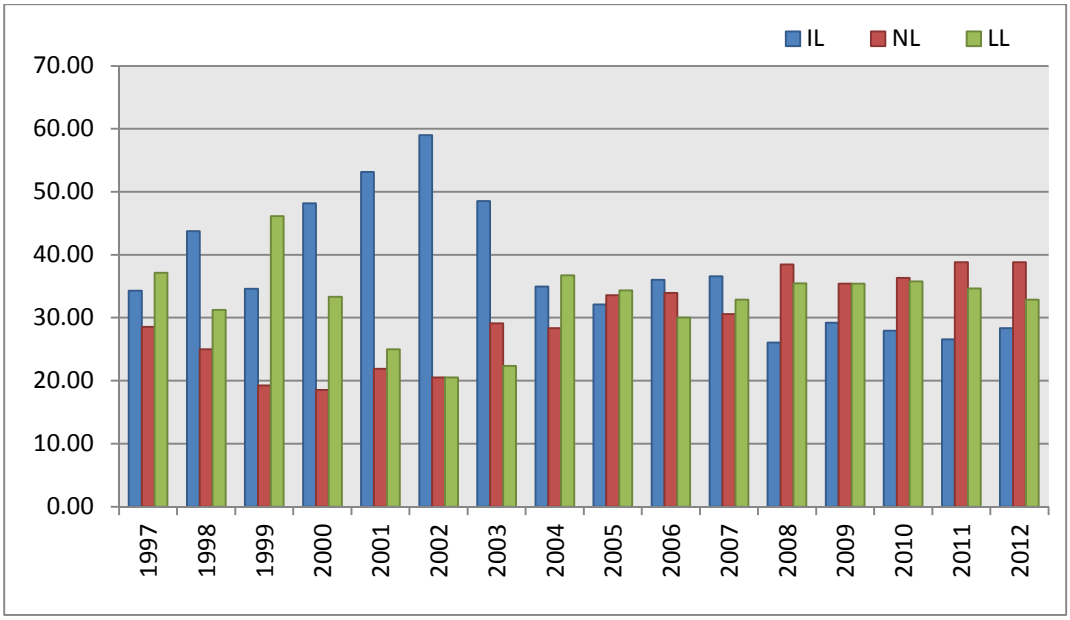

Figure 3 Year wise trend of collaboration at different levels

The growth rate and trend of the co-authored publications of three levels from 1997-2012 were computed by regression analysis using the log-linear equation. It is found that the number of internationally collaborated papers have increased 31 percent, where as the nationally collaborated papers reported growth of 45.4 percent. The local level collaboration shows an increase of 39.2 percent. The growth trend is illustrated in Figure 3. It is evident that the international collaboration reports a decreasing trend than the national and local level of collaboration during the period of study.

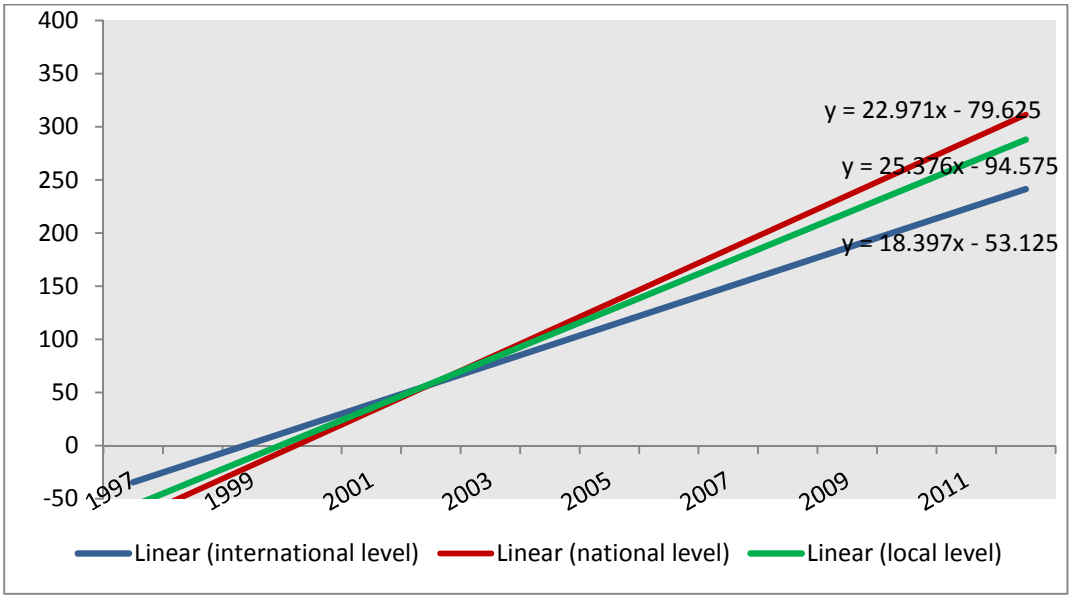

Table 4

Relationship between the levels of collaboration

Level of collaboration	N	Mean	Std. Deviation	Std. Error	F	Sig.
International collaboration	16	103.2500	90.20606	22.55152	0.105	0.901
National collaboration	16	121.1250	129.22326	32.30581		
Local collaboration	16	115.6250	116.44734	29.11184		
Total	48	113.3333	110.95511	16.01499		

The one way ANOVA is carried out to find out the relationship between the level of collaboration based on time based on the number of collaborative publications from 1997-2012 (Table 4). From the mean value it is evident that national level collaboration is more when compared to international and local level. From the observed F-value 0.105 and its corresponding P-value 0.901 it is concluded that there is no significant difference in all the three levels of collaboration, but the mean value shows there exist difference in their level of collaboration.

Collaboration pattern at international level

International scientific collaboration has witnessed dramatic quantitative and structural change since the last decades of the 20th century (Gla¨nzel and Schubert 2005). Advent of ICT has globalised the research blurring national borders, making research more globalized. Collaboration with international counterparts can occur because authors obtain better opportunities to share resources and expertise. In BM research, out of the 5440 joint authored papers, 1652 (30.36%) are co-authored at international level. The publications with international level collaboration are examined in detail to identify the collaborating countries with India. A total of 83 countries collaborate with India during 1997-2012. There shows dramatic increase in the number of collaborating countries who participate in BM research with Indian colleagues. In 1997 only six countries collaborate with India which rises to 50 in 2012 (Figure 4) and observes seven fold rise in the number of collaborating nations with India. On examining the co-operation pattern, it is observed that, most of the articles (79.7%) are written by authors from two countries; 15.8 percent of the articles show three countries in co-publication; and 2.5 percent four or more countries involved, considering one of them to be necessarily India. From this it is apparent that most of the collaborative papers have resulted by bilateral collaboration of the countries.

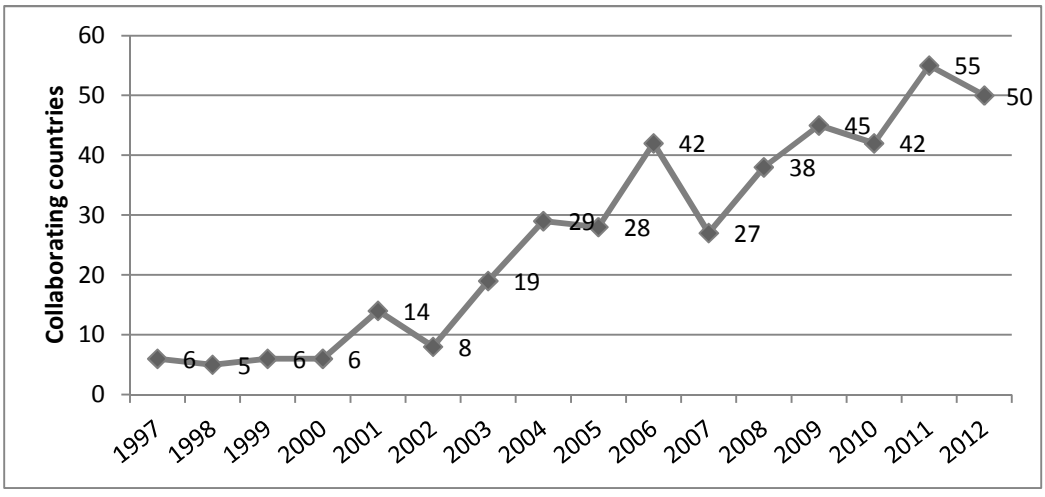

Figure 4 Collaborating countries with India

Geographical preferences in international collaboration

The geographical preference of Indian researchers in international collaboration is identified by finding out the most collaborated country in terms of frequency of collaborating publications. The rank list of 25 top collaborating countries in Business management research has been compiled and given in Table 5. The country preference of Indian researchers in BM research is visualised using GPS visualizer in Figure 5. The size of the circle depends on the quantum of collaboration. The top collaborating country is United states with 755 papers (3.78%). The United Kingdom comes second with collaboration in 224 papers (2.74%). The third ranked collaborating country is Canada with 132 papers (2.53%). Only16 countries show collaboration of at least one percent.

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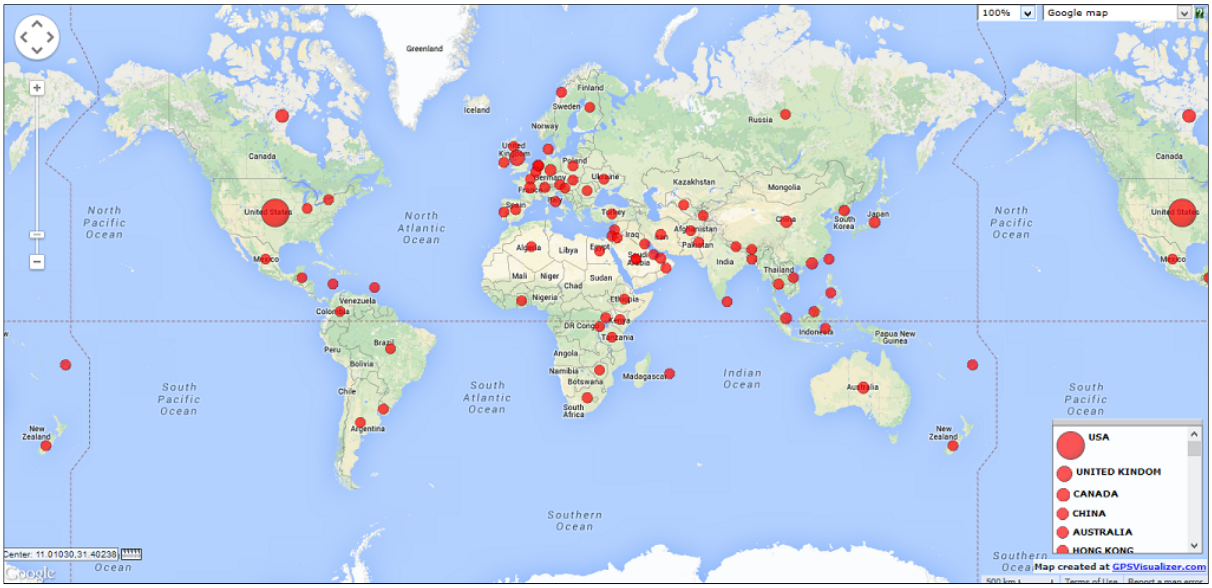

(the size of circle corresponds to intensity of collaboration)

Figure 6 Country preferences of Indian researchers for collaboration in BM research

Table 5

Ranking list of collaborating countries

Rank	Country	ISO Code	Frequency of publication	Percentage
1	United States of America	USA	755	35.28
2	United Kingdom	GBR	224	10.47
3	China	CHN	142	6.64
4	Canada	CAN	132	6.17
5	Australia	AUS	70	3.27
6	Netherlands	NLD	67	3.13

7	Germany	DEU	59	2.76
8	Singapore	SGP	54	2.52
9	Japan	JPN	49	2.29
10	France	FRA	46	2.15
11	Sweden	SWE	32	1.50
12	Korea	KOR	28	1.31
13	South Africa	ZAF	25	1.17
14	United Arab Emirates	ARE	23	1.07
15	Italy	ITA	22	1.03
16	Malaysia	MYS	22	1.03
17	Thailand	THA	22	1.03
18	Switzerland	CHE	21	0.98
19	Denmark	DNK	20	0.93
20	Fiji	FJI	18	0.84
21	Spain	ESP	18	0.84
22	Iran	IRN	16	0.75
23	New Zealand	NZL	14	0.65
24	Belgium	BEL	13	0.61
25	Oman	OMN	12	0.56

Co-operation pattern with top collaborating countries

The top 15 countries in co-publication are analysed in detail to examine the trend of collaboration prevailing for the past 16 years. The study period is divided into four quaternary periods and the results are presented in Table 5.33. It is apparent from the Table 5.33 that, the collaboration pattern of countries does not take place evenly and the top collaborating country USA is only one country that is actively collaborating in BM research with India from 1997-2012 continuously. UK had collaborated continuously from 1998 onwards. All 15 countries are collaborating with India from the last quarter years from 2009-2012, which indicates a healthy co-operation climate in research among the countries for the past four years. However, China, Netherlands and Singapore shows transience in the research partnership with India as there is no collaborated papers reported in more than two intermittent years during the time span of present study. The collaboration with foreign countries can be further enhanced by academic tie-ups, faculty exchange and joint degree programmes. The collaboration of foreign Universities to start campuses in India will promote the opportunities of joint research. Some of the top Business schools such as ISB have already started collaborating with foreign Universities

Table 6

Quadrennial distribution of co-operation pattern between the top collaborating countries with India

Rank	*Country*	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	**Total records**	*%*
		I				**II**				**III**				**IV**					
1	*United States*	5	4	6	7	8	14	23	37	48	48	84	87	84	90	87	123	755	35.28
2	*United Kingdom*	0	2	1	1	2	1	6	16	10	19	19	32	25	27	36	27	224	10.47
4	*China*	0	3	0	0	2	0	5	3	8	15	15	13	18	18	16	26		6.64
3	*Canada*	1	0	1	2	3	5	2	4	3	10	12	13	19	18	14	25	132	6.17
4	*Australia*	0	0	0	1	1	1	2	2	3	6	4	3	7	15	10	15	70	3.27
5	*Netherlands*	0	1	0	2	2	0	4	3	2	14	6	3	10	5	12	3	67	3.13
7	*Germany*	2	0	1	0	1	1	4	4	5	6	3	2	5	6	8	11	59	2.76
8	*Singapore*	0	0	0	0	2	0	0	8	0	8	6	2	9	4	10	5	54	2.52
9	*Japan*	0	0	0	0	0	0	5	4	1	8	5	3	9	5	4	5	49	2.29
10	*France*	0	0	0	0	0	0	0	2	2	3	0	7	4	7	6	15	46	2.15
11	*Sweden*	0	1	0	0	0	0	0	2	1	1	2	6	7	3	8	1	32	1.50
12	*Korea*	0	0	0	0	0	0	1	1	1	1	3	2	6	4	5	4	28	1.31
13	*South Africa*	0	0	0	0	0	1	1	2	4	2	1	5	3	1	3	2	25	1.17
14	*United Arab Emirates*	0	0	0	0	0	0	0	0	1	1	2	2	6	5	1	5	23	1.07
15	*Italy*	0	0	0	0	0	1	0	0	0	2	2	0	3	6	4	4	22	1.03
	Average productivity per year	0.5	0.7	0.6	0.9	1.4	1.6	3.5	5.9	5.9	9.6	10.9	12.0	14.3	14.3	14.9	18.1		

Columns in blue shows zero collaboration

The co-operation pattern of top collaborating countries with India, in quadrennial four block years from 1997-2012 is analysed and it is evident that the co-operation pattern of the collaborating countries shows a variation over the four block years as the average productivity per year shows significant variation form 0.5 in 1997 to 18.1 in 2012. The variance is statistically verified by applying one way ANOVA for the four block year period from 1997-2012. As the calculated value is greater than the tabulated value at 1 percent level it is proved that there exists significant difference in the research co-operation of India in international collaboration (Table 7&8).

Table 7

Variation in collaboration pattern among top collaborating countries

Quadrennial periods	***Count***	***Sum***	***Average***	***Variance***
1997-2000	15	41	2.733333	30.92381
2001-2004	15	186	12.4	411.8286
2005-2008	15	577	38.46667	4407.838
2009-2012	15	804	53.6	8465.257

Table 8

ANOVA

Source of Variation	***SS***	***Df***	***MS***	***F***	***P-value***	***Tabulated value***
Between Groups	24613.73	3	8204.578	2.46*	0.071715	2.769
Within Groups	186421.9	56	3328.962			
Total	211035.6	59				

Institutional (sectoral) collaboration

The affiliation details of co-authored publications are examined in detail to analyse at meso level, the nature of collaborating institutes. The affiliating institutes of contributing authors (both principal and co-authors) are examined and classified into academic and non-academic category. The academic category constitutes Universities, Business schools and

research institutes of academic character that venture in scholarly research and non-academic category constitutes industries and service organisations. The non academics primarily involve the management practitioners/professionals who involved in scholarly

Collaboration of academic and non-academic researchers

From the institute wise categorisation of research productivity given in Table 9, it is evident that the lion shares of the co-authored articles (85.07%) are from academic institutions in which both the principle author and co-authors are affiliated to the academic institutes. Only 4.49 percent are contributed by non academics/ researchers affiliated to (industries or service organisations). Tijssen et al. (2009) tried to analyze performance measurements and indicators based on university–industry research collaboration and from their study; the focus was made on which university is the best providers of research services to the business sector. The reason for low productivity of researchers in non–academic sector is the isolation of non-academics from research due to the less academic–industry interface. Hence in order to foster research among non-academics it is recommended to promote research collaboration with the academic sector. For this the industry can provide funding for University/ academic research and conduct exchange programme of professionals. Only 10.44 percent of publications are produced from the collaboration between academic and non-academic authors. This substantiates the above fact of less interaction between the academics and non academics in the research.

Aggregations of academic and non-academic collaboration

On analysing the level of collaboration, the academics in Business management discipline prefers more local collaboration i.e., collaboration within the same institute, than international level collaboration while non-academic researchers are more biased to the local research collaboration with 116 publications. The year wise distribution of academic level collaborations are observed in detail to examine the collaboration trend during the study period which shows a decline in internationally collaborated papers from the year 2002 in relation to the national and local level collaboration. It is interesting to note that, in case of inter collaboration between authors of academic and industry, internationally collaborated papers (256 papers) shows the highest frequency and it depicts that there is ample invisible colleges exits between the academic-industrial linked research activities involving India and foreign nationals.

Table 9

Distribution of collaborative papers in different aggregations

Nature of collaboration	**Level of collaboration***			
	IL	**NL**	**LL**	**Total (%)**
Between academics	1318	1585	1725	4628 (85.07%)
Between non academics	78	50	116	244 (4.49%)
Between academics and non-academics	256	303	9	568 (10.44%)
Total	1652	1938	1850	5440

*IL-International level, NL-National level, LL-Local level

Table 10

Relationship between nature of collaboration and levels of collaboration

Nature of collaboration	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**F**	**Sig.**	**Scheffe value**
between academics	3	1542.6667	206.77605	119.38221	86.544	.000	1Vs2, 1Vs3
between non academics	3	81.3333	33.12602	19.12532			
between academics and non academics	3	190.0000	158.35719	91.42757			
Total	9	604.6667	717.18826	239.06275			

The one way ANOVA is carried out to find out the relationship between nature of collaboration and levels of collaboration (Table 10). From the mean value it is evident that 'collaboration between academics' is very high when compared to between non-academics

and between academics and non academics. From the Table 5.36 it is further noted that the F-value is 86.54 which is significant at 0.01 percent level. Hence it is concluded that there is a significant relationship between nature of collaboration and levels of collaboration. From the scheffe value it is observed that this significant difference is due to the difference in between academics and between non-academics, between academics and between academics and non-academics.

Author order in co-authored papers

Author order is another important element in assigning the intensity of contribution among the authors in multi authored paper. In most cases, the first author is an individual who puts in the major work to complete the paper (Bhandari et al. 2003). In the data set of present study, on analysing the first authorship analysis based on the country it is interesting to find that among the internationally collaborated articles, only 43.77 percent have contributed by Indian researcher as a main author and remaining 56.36 percent as collaborator (Table 5.38 and Figure 5.17). This implies that in these papers there is comparatively less involvement to the Indian researchers but may points to a positively upon the collaboration trend of Indian scholars with foreign colleagues. On dividing the internationally collaborated publications into sector wise, 44.68 percent of academic category papers and 29.49 percent of non-academic papers have Indian researcher as main author.

Table 11

Author order in internationally collaborated publications

Collaboration	**Indian researcher as main author**	**Indian researcher as collaborating author**	**Total**
Between academics	589	729	1318
Between non academics	23	55	78
Between academics and non academics	109	147	256
	721	931	1652

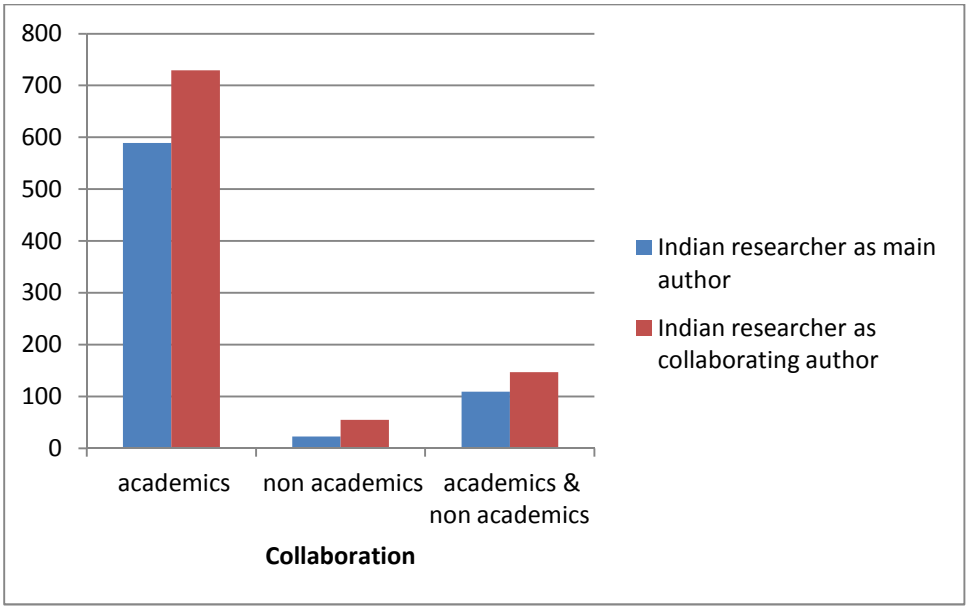

Figure 7 Author order in internationally co-authored publications

Top contributing institutes

The ranked list of top contributing 50 institutes in BM research during the period 1997-2012 is compiled based on the frequency of publication productivity. Table 5.39 shows the ranked list of top contributing 50 institutes in BM research during the period 1997-2012.

The Participative index (PaI) is calculated for the 50 top institutes. IIT Delhi that has contributed 302 papers with 3.78 percent is ranked first. The Indian Institute of Management, Bangalore stood second with 219 papers (2.74 %). The Indian Institute of Technology, Kharagpur occupies the third place with 161 papers (2.53 %). followed by University of Delhi with 161 papers (2.01%), Indian institute of Technology, Madras with 159 papers (1.99%), Indian institute of Management, Ahmedabad with 158 papers (1.98%) in the fourth, fifth and sixth rank respectively. The institutes of national importance and those in public sector such as IIMs has performed high in the frequency of research productivity. The B-school in private sector with high productivity are a few and the top contributors in the present data set are Indian School of Business, Hyderabad with 106 papers (1.33 %), ICFAI business school, Hyderabad with 63 papers (0.79%) and Xavier Labour Relations Institute (XLRI), Jamshedpur with 46 papers(0.58%). The institutes in government sector and autonomous institutes has performed high in the frequency of research productivity. The University of Delhi topped the list, among the Universities followed by Jadavpur University,

Kolkata with 107 papers (1.34%), Anna University, Chennai with 101 papers, (1.26%), Aligarh Muslim University with 45 papers (0.56%).

The Management Development institute, Gurgaon with 135 papers and Indian Statistical Institute with 129 papers (1.61%) are the prominent academic research institutes with high productivity. The Reserve bank of India, Department of Economic analysis and Policy, Mumbai with 58 papers (0.73%), Tata consultancy Services with 34 papers (0.43%) and Infosys Technologies Limited, Tata Management Training Centre, Pune with 21 papers (0.26) are some of the non academic (industry/ service organization) topped in productivity.

The rank list of top productive institutions shows that in India, academic institutes of national importance like IITs and IIMs are still dominates in the scholarly research in the discipline. The universities and institutes in private sector lags behind with only few contributions. The research contribution of industries and service organization in the management sector is also less and still not fully active in the scholarly activity.

Table 12

Prolific institutes in BM research

Rank	**Institution**	**Frequency of contribution**	**PaI (%)**
1	Indian Institute of Technology, Hauz Khas, New Delhi 110 016, India	302	3.78
2	Indian Institute of Management, Bannerghatta Road, Bangalore 560076, India	219	2.74
3	Indian Institute of Technology, Kharagpur-721302, India	202	2.53
4	University of Delhi, Delhi, 110 007, India	161	2.01
5	Indian Institute of Technology, Madras 600 036, India.	159	1.99
6	Indian Institute of Management, Vastrapur, Ahmedabad 380015, India`	158	1.98
7	Indian Institute of Science, Bangalore 560012, India	144	1.80
8	Management Development Institute, Gurgaon 122001, India	135	1.69
9	Indian Statistical Institute, 203 B.T. Road, Kolkata - 700108, India	129	1.61
10	Indian Institute of Technology Roorkee, Roorkee-247 667, Uttaranchal, India	120	1.50
11	Indian Institute of Management, Calcutta 700 027, India	120	1.50
12	Indian Institute of Technology Bombay, Mumbai 400076, India	114	1.43

13	Jadavpur University, Kolkata - 700 032, India.	107	1.34
14	Indian School of Business, Gachibowli Hyderabad 500019, India	106	1.33
15	Anna University, Chennai-600 025, India	101	1.26
16	Institute of Management Technology, Ghaziabad, India	101	1.26
17	Indian Institute of Technology Kanpur, Kanpur 208016, India	99	1.24
18	Indian Institute of Management, Lucknow, India 226013.	97	1.21
19	ICFAI business school, Hyderabad	63	0.79
20	Reserve Bank of India, Shahid Bhagat Singh Road Mumbai 400001 India	58	0.73
21	Birla Institute of Technology and Science, Pilani, Rajasthan - 333 031, India	50	0.63
22	National Institute of Technology, Tiruchirappalli - 620015, India	50	0.63
23	Xavier Labour Relations Institute (XLRI), Jamshedpur, India	46	0.58
24	Aligarh Muslim University, Aligarh, India	45	0.56
25	Jawaharlal Nehru University, New Delhi, India 110067	45	0.56
26	Administrative Staff College of India, Hyderabad, India.	44	0.55
27	Pondicherry University, Kalapet, Puducherry 605 014, India	43	0.54
28	ICFAI Business School, Kolkata, India	43	0.54
29	Institute for International Management and Technology, 336, Udyog Vihar, Phase-IV, Gurgaon-122001, Haryana, India	42	0.53
30	University of Burdwan, Burdwan, West Bengal 713104, INDIA	40	0.50
31	National institute of foundry and forge technology (NIFFT), Ranchi 834003, India	39	0.49
32	Annamalai University, Annamalainagar 608002, Tamil Nadu, India	39	0.49
33	Indian institute of managementK Campus P.O. Kozhikode-673570, Kerala, India	39	0.49
34	Indian Institute of Management Kozhikode, Kuanamangalam P.O., Calicut -- 673 571, India	39	0.49
35	ICFAI Business School, Bangalore, India	38	0.48
36	Xavier Institute of Management, Bhubaneswar, Orissa, India	37	0.46
37	Indira Gandhi Institute of Development Research	36	0.45
38	Tata Consultancy Services	34	0.43
39	National Institute of Industrial Engineering (NITIE), Vihar Lake, Mumbai - 400 087 (India)	34	0.43
40	Banaras Hindu University , Varanasi India	32	0.40

41	Indian Institute of Management Indore, Indore-453 331, India	32	0.40
42	Osmania University, Hyderabad - 500 007, AP. India	30	0.38
43	Gujarat University, Ahmedabad 380009, Gujarat, India	29	0.36
44	University of Mumbai, Matunga Road, Mumbai - 400 019, INDIA	29	0.36
45	Kurukshetra University, Kurukshetra 136 119, Haryana, India	28	0.35
46	Institute of Economic Growth, Delhi University Enclave, Delhi - 110 007, India.	28	0.35
47	Infosys Technologies Limited, India	25	0.31
48	National Institute of Bank Management (NIBM), Pune, Maharashtra	24	0.30
49	Tata Management Training Centre, Pune, 411 011, India	21	0.26
50	National Institute of Technology, Calicut 673601, Kerala, India	21	0.26

Suggestions and conclusion

Collaboration has been the salient feature of current science research organizations and academic institutes. The change from little science to big science has resulted in a shift from solo research to team research. The reason for collaboration in scholarly activity is compounded by several variables such as institutional policies, financial support, and nature of subject of investigation. Evaluating the scientific output using, that is, published paper as an indicator has been a conventional practice since long in scientometric studies and the research collaboration is indicated by the frequency of co-authored papers. The present study has investigated on the current scenario of scholarly collaboration in the field of Business management research in India in terms of co-authored publication in multiple perspectives. As there is wide felt variation in collaboration trend in various disciplines, it is apparent from the study that the collaboration plays significant role in the research scenario even in soft discipline like Business management. As the study has found there is significant correlation between collaboration and productivity, it is necessary to promote the collaboration ventures in Business Management discipline to increase the scholarly productivity. Unlike pure science disciplines, less funding is allotted at present to disciplines under Social sciences and Humanities. But, due to the emerging importance to the social science disciplines such as Business Management, sociology, Ecology adequate funding should be given according the significance of research projects. The measure should be taken to promote collaboration at academic level and between academic and non-academic sectors. The collaboration in the academic sector can be encouraged by exchange programmes and adequate funding. The industry-academic tie-ups should be motivated by initiating the policies for funding from

industries to carry out academic research for the mutual benefit of both. The research collaboration especially at international level is found decreasing and it is the need of the hour to promote the Indian management research to global arena. The publication in international level journals will helps in improving the visibility of Indian research in the discipline. The international level collaborations need to encourage further bringing out quality publications as well as diversity in research. It also helps in better visibility of Indian management problems at global level which would also increase the citation rate of publication. The academic tie up in education should be extended to research also by partnering with global business schools. The International Faculty development Programme, student exchange programmes, teaching forums with international institutes will provide ample opportunities to reach with foreign researchers. The ISB has made the following initiatives such as visiting faculty from the leading global B-schools — Wharton, Kellogg, London Business School, Cornell, Chicago, Duke, UCLA, etc, Joint faculty exchange programmes with MIT Sloan and participation of faculty members of the Kellogg School of Management and the Wharton School in designing curricula, research conferences as well as in recruitment of faculty. This could be achieved by more scientists attending and presenting their research results in international conferences which would lead to more collaboration.

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